

### **REMARKS**

By this Response, Claim 7, 11, 12, and 14 has been amended. Thus, Claims 7-15 are now pending. The amendments to the claims have been made to rephrase the claims for clarity. No new matter is added by the amendments as discussed below. Applicants respectfully request the entry of the amendments and reconsideration of the application in view of the above amendments and the following remarks.

#### **Discussion of Rejections of Claims 7-15 under 35 U.S.C. §112**

Claims 7-15 were rejected under 35 U.S.C. 112, second paragraph. Claim 7 was rejected for lacking of antecedent basis for the term "the methane reforming catalyst layer" and Claim 12 was rejected for being narrative and indefinite. In reply, Applicants have amended Claims 7 and 12 to address this concern.

#### **Discussion of Rejections of Claims 7-15 under 35 U.S.C. §103(a)**

Claims 7-15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Song et al. (Synthesis Gas Production via Dielectric Barrier Discharge Over Ni/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalyst), hereinafter "Song," in view of US 6,284,157 B1 to Eliasson et al., hereinafter "Eliasson." Applicants respectfully disagree with the Examiner and submit that these references are non-obvious over Claims 7 and as discussed below.

#### **Disclosure of Song**

Song teaches methane conversion from CO<sub>2</sub> reforming of methane using dielectric barrier discharge over Ni/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalyst. Song also teaches a cold trap for discharging synthetic gas. However, Office Action on page 4 correctly acknowledges that Song does not teach reacting the methane and oxygen containing compound while heating a heating element proximal to the catalyst to a temperature of about 200 to 400 °C. Consequently, Eliasson was introduced to remedy this failure of Song.

Disclosure of Eliasson

The Office Action stated on page 5 that Eliasson teaches the reaction temperature in the reaction space can be kept constant at a predetermined temperature, for example up to 350 °C, by means of a heating device.

Discussion of Patentability of Claims 7-15

When compared with teachings of Song, Applicants' claimed invention according to Claim 7 provides surprising advantageous results by utilizing a quartz tube, a metal film outer electrode, and reacting the methane and oxygen containing compound under the influence of a heating element at a temperature of about 200 to 400 °C. The advantageous experimental results are disclosed by the Applicants to show that the conversion rates for reactants, for example CO<sub>2</sub> and CH<sub>4</sub> (methane), are very high and C<sub>2</sub>-C<sub>4</sub> hydrocarbon generations are almost nonexistent.

The Applicants disclose, in Table 3 on page 13 of their disclosure (as reproduced below), CO selectivity is 80.38% and CO<sub>2</sub> conversion rate is 93.87% when the heating member is heated to about 200 °C. Furthermore, Table 3 shows that the generation of other hydrocarbons such as ethane, propane, and the like is 0% to 0.07% and, thus, it can be said that the generations of C<sub>2</sub>-C<sub>4</sub> hydrocarbons are substantially nonexistent. As described on Page 15 of the present application, total input energy to produce this high conversion efficiency and low hydrocarbon generation was only about 80 W, which includes both 50 W for the voltage source, and 30 W for the heater.

Table 3

Temperature of heating member(°C)	Conversion rate (%)		Selectivity (%)							H <sub>2</sub> /CO ratio
	CH <sub>4</sub>	CO <sub>2</sub>	CO	C <sub>2</sub> H <sub>2</sub>	C <sub>2</sub> H <sub>4</sub>	C <sub>2</sub> H <sub>6</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>3</sub> H <sub>8</sub>	C <sub>4</sub> H <sub>10</sub>	
R.T.	40.18	25.07	51.81	0.0	0.61	14.13	0.48	6.22	3.34	1.41
100	36.13	22.98	51.70	0.0	0.99	15.54	0.05	6.29	3.26	1.40
200	93.68	93.87	80.38	0.0	0.0	0.07	0.0	0.0	0.0	1.21

In contrast, Song discloses, in Table 4 reproduced below, that the methane and CO<sub>2</sub> conversion rates are less than 60%. Song further discloses that the selectivity of C<sub>2</sub>-C<sub>4</sub> hydrocarbon is about 10% to 3% and therefore large amounts of various hydrocarbons are simultaneously produced. In Table 1, Song further shows that increasing the input power to 130 W does not improve conversion efficiency.

Table 4  
Effect of nickel contents

Loading weight (%)	Conversion (%)		H <sub>2</sub> /CO ratio	Selectivities (%)					
	CH <sub>4</sub>	CO <sub>2</sub>		CO	C2	C3	C4	Carbon sum	H <sub>2</sub>
2	55.44	32.7	1.06	60.6	9.83	5.90	3.21	79.54	52.25
5	55.71	33.48	1.04	60.9	10.12	5.85	3.15	80.02	51.92
7	55.47	32.61	1.03	63.87	10.6	6.09	3.56	84.12	53.48
10	55.15	32.66	1.06	61.37	10.63	6.20	3.42	81.62	52.98

In regard to Eliasson, this reference also teaches similar conversion efficiencies as Song. Although Eliason states that the heating element can be heated to up to 350 C, preferably the temperature is less than 100 C, as set forth in column 2, line 46 of this reference. Furthermore, the generation of various hydrocarbons and liquid hydrocarbons in addition to the synthesis gas is not resolved by Eliasson.

Therefore, Song and Eliasson, in combination or alone, do not hint at the dramatic improvement in conversion efficiency at low input power that can be obtained by the correct combination of dielectric, electrodes, catalyst, and temperature. Meanwhile, there is no additional prior art or explanation of the knowledge of one having ordinary skill in the art to remedy the deficiencies of the cited references. Further, there is no explanation as to why the differences between the prior art and the claimed invention would have been obvious to one of ordinary skill in the art. Therefore, Applicant respectfully submits that no *prima facie* case of obviousness has been established with respect to Claim 7 and its dependent claims, Claims 8-15, and these Claims are patentable.

#### **Dependent Claims**

Although Applicants have not addressed all the issues of the dependent claims, Applicants respectfully submit that Applicants do not necessarily agree with the characterization and assessments of the dependent claims made by the Examiner, and Applicants believe that each claim is patentable on its own merits. Applicants respectfully submit that pursuant to 35 U.S.C.

**Application No.:** 10/558,843  
**Filing Date:** November 29, 2005

§ 112, ¶4, the dependent claims incorporate by reference all the limitations of the claim to which they refer and include their own patentable features, and are therefore in condition for allowance. Therefore, Applicants respectfully request the withdrawal of all claim rejections and prompts allowance of the claims.

**No Disclaimers or Disavowals**

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicants are not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicants reserve the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

**Conclusion**

Applicants submit that all claims are in condition for allowance. However, if minor matters remain, the Examiner is invited to contact the undersigned at the telephone number provided below.

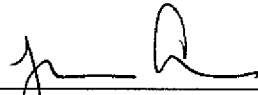
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Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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